

ON THE CRAYFISHES (DECAPODA: CAMBARIDAE) OF THE NECHES RIVER BASIN OF EASTERN TEXAS WITH THE DESCRIPTIONS OF THREE NEW SPECIES

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Abstract.—Among the 13 crayfishes recorded here from the Neches River basin in eastern Texas are three that are previously undescribed: *Procambarus* (*Girardiella*) *nigrocinctus*, *P. (G.) kensleyi*, and *P. (Ortmannicus) nechesae*. The first has its closest affinities with *P. (G.) tulaneii* Penn, the second with *P. (G.) parasimulans* Hobbs and Robison, and the third is a close relative of *P. (O.) geminus* Hobbs. Present also in the Basin is a member of the genus *Cambarellus*, two representatives of the genus *Cambarus*, two belonging to the genus *Fallicambarus*, a member of the genus *Faxonella*, and four other species of *Procambarus*. New locality records are cited for all of them.

With the intent of stimulating an interest in the crayfish fauna of Texas, the late George Henry Penn, Jr., and I summarized (1958) all of the information available to us concerning the crayfishes of Texas and provided a key to the species and subspecies recognized at that time. Unfortunately, few contributions extending our knowledge of the fauna have appeared since. Among them is that of Rollin D. Reimer (1969) whose unpublished dissertation contains descriptions of several unnamed new taxa and records that are in need of further attention. One of the species (“*Procambarus* species E”) included in the dissertation was cited as occurring in the Navasota River basin by Reimer & Clark (1974) in their summary of the decapod crustaceans occurring in that basin. In the following year this crayfish was described under the name of *Procambarus* (*Girardiella*) *curdi* by Reimer (1975). Two of the species described herein were almost certainly recognized by Reimer and were cited by him as occurring in the Neches River basin: his “*Procambarus* species F” is almost certainly conspecific with *P. (Girardiella) nigrocinctus* described below, and his *Procambarus* species G” embraces, if it is not identical with, *P. (G.) kensleyi* which is also described herein. As noted by Hobbs

& Robison (1982:545), reluctance exists in describing crayfishes that almost certainly were recognized as undescribed by Dr. Reimer, but receiving no response to repeated attempts to communicate with him, descriptions of these two species are included here.

Hobbs (1971) described *Procambarus* (*Ortmannicus*) *texanus* from the fish hatchery near Smithville, Bastrop County, but no records of its presence elsewhere have been reported. Unpublished is a detailed study of the life histories of two crayfishes occurring in southeastern Texas by Albaugh (1973). A new species belonging to the genus *Procambarus* was described by Albaugh (1975) and another of the genus *Cambarellus* by Albaugh & Black (1973). In 1986, I was greatly surprised to learn of the existence of a crayfish pest in the eastern prairie section of Texas that had caused concern to farmers and to residents with lawns for a number of years, if not for generations. How *Fallicambarus* (*F.*) *devastator* Hobbs & Whiteman (1987) escaped earlier attention of students of crayfishes remains unanswered to date. In attempting to obtain information on the distribution and biology of this crayfish (See Hobbs & Whiteman 1990), specimens of other species of cam-

barids, including three that were previously undescribed, were found within and bordering its range. Their occurrence within the area frequented by *F. (F.) devastator* are recorded herein.

It would be desirable to compare the crayfish fauna of the Neches River basin with that of other river systems along the western Gulf Slope as has been so admirably done for the freshwater fishes by Conner & Suttus (1986). Unfortunately the crayfish fauna has not been determined for a single stream between the Mississippi River and the Rio Grande. Certainly the present report does not represent a complete inventory of the crayfishes of the Neches Basin. The only survey of a Texas watershed that has produced a perhaps near-exhaustive list of the crayfishes occurring within it is the study of Reimer & Clark (1974) on the Navasota watershed, a tributary of the Brazos River. They found ten species of crayfishes, six of which are reported herein to occur also in the Neches Basin: *Cambarellus (Pandicambarus) puer* Hobbs, 1945, *Fallicambarus (C.) hedgpethi* (Hobbs, 1948) (= *F. (C.) fodiens* (Cottle, 1863); see Hobbs & Robison 1989), *Cambarus (L.) ludovicianus* Faxon, 1884, "*Procambarus species A*" (= *P. (Girardiella) curdi*), *P. (Ortmannicus) acutus* (Girard, 1852), and *P. (Scapulicambarus) clarkii* (Girard, 1852). I am aware of no records for *Procambarus (Capillicambarus) incilis* Penn (1962), *P. (G.) simulans* (Faxon, 1884), *P. (G.) species B*, and *Orconectes (Buanulifictus) palmeri longimanus* (Faxon, 1898) in the Neches watershed.

Perhaps this exposure of the comparative richness of the crayfish fauna of the Neches River basin will induce a more thorough survey by others of the crayfishes frequenting this and neighboring watersheds.

Family Cambaridae

Subfamily Cambarellinae

Cambarellus (Pandicambarus) puer Hobbs

Cambarellus puer Hobbs, 1945:469.

Cambarellus (Pandicambarus) puer. — Fitzpatrick, 1983:268.

New record. — Jasper Co.: Edge of creek 9.2 mi (14.7 km) NW of US Hwy 190 on St Rte 63, 3 ♂ II, 2 ♀, 17 Apr 1987, G. B. Hobbs & HHH.

Subfamily Cambarinae

Cambarus (Lacunicambarus) diogenes

Girard

Cambarus diogenes Girard 1852:88.

Cambarus (Lacunicambarus) diogenes. — Hobbs, 1969:110.

New records. — Newton Co.: 2.7 mi (4.3 km) NW of Newton (Courthouse) on US Hwy 190, 2 j♀, 11 Nov 1987, Brian F. Kensley & HHH. Polk Co.: 6.2 mi (9.9 km) NE of Farm Rd 3152 on Rd 350, 1 ♀, 13 Nov 1987, BFK & HHH. Tyler Co.: 2.7 mi (4.3 km) E of Horse Pen Creek on US Hwy 190, 2 ♂ II, 2 ♀, 13 Nov 1987, BFK & HHH.

Remarks. — These specimens belonging to the subgenus *Lacunicambarus* are only tentatively assigned to this species. The ranges and limits of variation of the few described members of this species group are currently receiving a long-needed review by Raymond F. Jezerinac. All of the specimens cited were obtained from burrows.

Cambarus (Lacunicambarus)

ludovicianus Faxon

Cambarus diogenes var. *Ludoviciana* Faxon, 1884:144.

Cambarus (Lacunicambarus) ludovicianus. — Hobbs, 1990.

New records. — Angelina Co: 5.6 mi (9 km) NW of US Hwy 59 on Farm Rd 2497, 1 ♀, 15 Apr 1987, GBH & HHH. Jasper Co.: 9.0 mi (14.4 km) SW of Jasper on US Hwy 190, 2 j♂ 1 j♀, 16 Apr 1987, GBH & HHH. Polk Co.: 12 mi (19.2 km) E of Livingston on US Hwy 190, 2 j♀, 16 Apr 1987, GBH & HHH. 12.5 mi (20 km) E of Livingston on US Hwy 190, 1 ♀, 16 Apr 1987, GBH & HHH. 7.0 mi (11.2 km) W of US Hwy 287 on Farm Rd 1745, 1 ♂ I, 2 ♀, 12 Nov 1987, R. Armentrout, J. David, BFK, HHH. San Augustine Co.: 19.4 mi (31 km) NE of Zavalla

on US Hwy 69, 1 ♂ II, 1 ♀, 17 Apr 1987, GBH & HHH. 1.7 mi (2.7 km) NE of San Augustine on Farm Rd 353, 8 Nov 1987, 1 ♂ II, BFK & HHH.

Remarks.—See “Remarks” under *Cambarus (L.) diogenes* which are also applicable here. All of the specimens cited were obtained from burrows.

Fallicambarus (C.) fodiens

Astacus fodiens Cottle 1863:217.

Cambarus hedgpethi Hobbs, 1948:224.

Fallicambarus (Creaserinus) fodiens.—Hobbs, 1973:463.—Hobbs & Robison, 1989:672.

New records.—Angelina Co.: southeastern part of Lufkin, 1 ♀, 13 Apr 1987, Mike Whiteman & HHH. 3 mi (4.8 km) NW of US Hwy 59 on Farm Rd 2497, 1 ♂ I, 6 ♀, 14 Apr 1987, GBH & HHH. 4.2 mi (6.7 km) NW of US Hwy 59 on Farm Rd 2497, 1 ♂ I, 3 ♀, 1 j♂, 14 Apr 1987, GBH & HHH. 5.6 mi (9 km) NW of US Hwy 59 on Farm Rd 2497, 1 ♂ I, 1 ♂ II, 8 ♀, 14 Apr 1987, GBH & HHH; 3 ♂ II, 5 ♀, 1 j♂, 1 j♀, 15 Apr 1987, GBH & HHH. 7.7 mi (12.3 km) NW of Hwy 59 on Farm Rd 2497, 2 j♂, 1 j♀, 15 Apr 1987, GBH & HHH; 4 j♂, 2 j♀, 9 Nov 1987, BFK & HHH. Jasper Co.: 0.3 mi (0.5 km) N of Angelina River on St Rte 63, 2 ♂ II, 1 ♀, 11 Nov 1987, BFK & HHH. 0.2 mi (0.3 km) SE of Angelina River on St Rte 63, 2oII, 11 Nov 1987, BFK & HHH. 3.1 mi (5 km) SE of Angelina River on St Rte 63, 1 ♂ I, 1 ♀, 1 j♂, 4 ovig. ♀, 11 Nov 1987, BFK & HHH. Polk Co.: 5.0 mi (8 km) W of Livingston on US Hwy 190, 1 ♂ II, 13 Nov 1987, BFK & HHH. Trinity Co.: 4 mi (6.4 km) SW of Farm Rd 357 on Rd 2262, 1 ♂ II, 16 Nov 1987, BFK & HHH. 9.0 mi (14.4 km) SW of Farm Rd 357 on Rd 2262, 1 ♂ II, 1 ♀, 16 Nov 1987, BFK & HHH. 10.6 mi (17 km) SW of Farm Rd 357 on Rd 2262, 1 ♀, 16 Nov 1987, BFK & HHH.

Remarks.—This crayfish has been treated in considerable detail by Hobbs & Robison (1989). All of the adult specimens cited here were obtained from burrows, most of the juveniles from temporary roadside pools.

Fallicambarus (Fallicambarus) devastator
Hobbs & Whiteman

Fallicambarus (Fallicambarus) devastator
Hobbs & Whiteman, 1987:403.

New records.—8 localities in Angelina, Houston, Polk, Trinity, and Tyler counties (see Hobbs & Whiteman 1990). Except for a few specimens in one locality obtained near or at the mouths of burrows at night, all were removed from burrows that were excavated.

Faxonella beyeri (Penn)

Orconectes (Faxonella) beyeri Penn, 1950: 166.

Faxonella beyeri.—Creaser, 1962:3.

New record.—Angelina Co.: 4.2 mi (6.7 km) NW of US Hwy 59 on Farm Rd 2497, 3 ♂ I, 48 ♂ II, 48 ♀, 14 Apr 1987, GBH & HHH. 5.6 mi (9 km) NW of US Hwy 59 on Farm Rd 2497, 2 ♂ I, 7 ♂ II, 8 ♀, 15 Apr 1987, GBH & HHH. Jasper Co.: 8.7 mi (13.9 km) NW of St Rte 63 on US Hwy 190, 1 j♀, 17 Apr 1987, GBH & HHH. San Augustine Co. 19.4 mi (31 km) NE of Zavalla on St Rte 147, 1 ♂ I, 2 ♀, 17 Apr 1987, GBH & HHH.

Remarks.—Specimens of this species from the Neches River Basin are distinctly larger than any members of the species that I have examined from elsewhere. The largest first form male and female, both from the last locality cited, have carapace lengths of 18.2 and 19.6 mm, respectively. All of the specimens cited were taken from among vegetation in open water.

Procambarus (Girardiella) curdi Reimer

Procambarus species E.—Reimer 1969:64.
Procambarus species A.—Reimer & Clark, 1974:171.

Procambarus (Girardiella) curdi Reimer, 1975:22.

New records.—Angelina Co.: ditch at jct of farm rds 287, 1336, & 324 in SW part of Lufkin, 16 j♂, 21 j♀, 13 Apr 1987, MW,

Table 1.—Measurements (mm) of *Procambarus* (*G.*) *nigrocinctus*.

	Holotype	Allotype	Morphotype
Carapace:			
Entire length	37.5	42.2	31.2
Postorbital length	29.2	33.4	23.3
Width	2.1	2.2	1.6
Height	17.5	20.5	13.3
Areola:			
Width	2.1	2.2	1.6
Length	11.1	13.5	9.3
Rostrum:			
Width	5.9	6.6	4.9
Length	—	10.5	9.1
Right chela:			
Length, palm mesial margin	10.4	8.7	4.8
Palm width	11.4	9.9	5.7
Length, lateral margin	31.5	26.2	15.8
Dactyl length	18.5	16.2	9.3
Abdomen:			
Width	14.7	18.1	11.9
Length	39.4	42.1	32.2

GBH, HHH. 2.4 mi (3.8 km) NW of US Hwy 59 on Farm Rd 2497, 1 ♂ II, 3 ♀, 1 j♂, 6 j♀, 14 Apr 1987, GBH & HHH. 5.6 mi (9 km) NW of US Hwy 59 on Farm Rd 2497, 1 ♂ II, 4 ♀, 1 j♂, 1 j♀, 14 Apr 1987, GBH & HHH; 2 ♂ II, 2 ♀, 4 j♂, 5 j♀, 15 Apr 1987, GBH & HHH. 7.7 mi (12.3 km) NW of US Hwy 59 on Farm Rd 2497, 2 ♀, 4 j♂, 3 j♀, 15 Apr 1987, GBH & HHH; 2 ♂ I, 3 ♂ II, 2 ♀, 1 j♂, 5 j♀, 9 Nov 1987, BFK & HHH. 0.3 mi (0.5 km) W of Farm Rd 326 on Rd 1475, 1 ♀, 1 j♂, 10 Nov 1987, BFK & HHH. Angelina County Airport, 1 ♀, 10 Nov 1987, BFK & HHH. 1.3 mi (2.1 km) W of Shawnee Creek on Farm Rd 1818, 13 j♂, 11 j♀, 11 Nov 1987, BFK & HHH. NW city limits of Zavalla on US Hwy 69, 1 ♀, 1 ♀ with young, 11 Nov 1987, BFK & HHH. Polk County: 15.1 mi (24.2 km) SE of Trinity on St Hwy 356, 1 j♀, 16 Apr 1987, GBH & HHH. 2.4 mi (3.8 km) W of Tyler Co line on US Hwy 190, 1 ♀, 13 Nov 1987, BFK &

HHH. 1.8 mi (2.9 km) N of Farm Rd 350 on Rd 3152, 1 j♀, 13 Nov 1987, BFK & HHH.

Remarks.—This crayfish does not shun sandy soil in which the burrows, consisting of a single shaft and lacking conspicuous chambers, spiral to depths of as much as one meter. Whereas most of the specimens cited were retrieved from burrows, a few were found in roadside pools, several of which were temporary.

Procambarus (*Girardiella*) *nigrocinctus*,
new species
Figs. 1, 2a, Table 1

Procambarus species F.—Reimer, 1969:68.

Diagnosis.—Body pigmented, eyes well developed. Rostrum with marginal spines, lacking median carina. Carapace with strong cervical spine. Areola 4.5 to 6.2 (mean 5.4 ± 0.77) times as long as broad and constituting 28.5 to 31.6 (mean 30.0 ± 1.20) percent of total length of carapace (36.8 to 40.9, mean 39.1 ± 1.42 , percent of postorbital carapace length). Suborbital angle very weak and obtuse; hepatic area with few small tubercles; branchiostegal spine comparatively strong. Antennal scale about 2.5 times as long as broad, widest at about midlength. Mesial surface of palm of chela bearded; ventral surface tuberculate, tubercles present along proximal half of ventral surface of dactyl. Ischium of third pereopod in first form male with simple strong hook overreaching basioischial articulation; hook opposed by small setiferous tubercle on corresponding basis; coxa of fourth pereopod lacking caudomesial boss. First pleopods of first form male reaching coxae of third pereopods, symmetrical, bearing proximomesial spur and somewhat produced cephalic shoulder at base of terminal elements, lacking lateral subterminal setae, setae on caudoproximal ridge directed caudally, not flared; terminal elements (all sclerotized at least distally) consisting of (1) straight, tapering, subpiculiform, distally directed

mesial process; (2) short, acute, distally directed cephalic process; (3) strong, acute, cephalocaudally flattened, and distally disposed central projection not overreaching (4) conspicuous, somewhat tapering, obliquely positioned caudal element; latter consisting of caudomesially excavate lamelliform lobe and lacking distinct digitiform prominence. Lamelliform lobe and central projection reaching almost same level distally. Female with annulus ventralis freely movable, about 1.3 times as long as broad, and subrhomboidal (but tilted) in outline; cephalomedian trough broadening rapidly posteriorly by strong dextral divergence of dextral wall; sinus originating adjacent to wall near midlength of annulus, and, after extending mesially to median line, following sinuous course caudally, ending on caudomedian surface of annulus; cephalic part of sinistral wall bordering trough tuberculate. Preannular plate poorly developed; first pleopods present.

Holotypic male, form I.—Cephalothorax (Fig. 1a, 1, 2a) subcylindrical. Second segment of abdomen distinctly narrower than thorax (14.7 and 18.1 mm). Areola 5.3 times as long as broad and with 4 or 5 punctations in narrowest part. Cephalic section of carapace approximately (rostrum broken) 2.4 times as long as areola, latter comprising about 29.5% of total length of carapace (38.0% of postorbital carapace length). Surface of carapace punctate dorsally, strongly granulate laterally; most tubercles in hepatic area little, if any, larger than granules on branchiostegites. Rostrum broad basally, tapering gently anteriorly from level of orbit (apical part of rostrum missing in holotype but in other specimens gradually diminishing in width to well developed marginal spines; slightly upturned tip reaching ultimate podomere of antennular peduncle); margins not thickened; dorsal surface, lacking median carina, concave with punctations scattered between submarginal rows. Subrostral ridges weak and evident in dorsal view only slight distance anterior to pos-

terior margin or orbit. Postorbital ridges prominent, each ending anteriorly in corneous spine. Suborbital angle weak and obtuse. Branchiostegal spine and cervical spine well developed.

Abdomen (Figs. 1k, 2a) subequal in length to carapace in all specimens. Cephalic section of telson with 3 spines in each caudolateral corner, lateral and mesial ones fixed. Cephalic lobe of epistome (Fig. 1i) campanulate with slightly irregular, weakly-thickened anterolateral margins; main body of epistome with distinct fovea. Ventral surface of proximal podomere of antennular peduncle with small spine near midlength. Antennal peduncle with well developed spine on both basis and ischium; flagellum almost reaching midlength of telson. Antennal scale (Fig. 1m) 2.5 times as long as broad, widest near midlength; greatest width of lamellar area 1.7 times that of thickened lateral part.

Third maxilliped extending slightly distal to spine on ventral surface of basal podomere of antennule, ventral surface of podomeres proximal to propodus largely obscured by long plumose setae; lateral surface of all except distalmost part of merus hidden in lateral aspect.

Right chela (Fig. 1p) subovate in cross section, somewhat depressed; palm about 1.1 times as broad as length of mesial margin; latter little more than one-third total length of chela; entire palm studded with tubercles, although those on and adjacent to mesial surface hidden by beard of plumose setae; 7 or 8 tubercles present in mesialmost row, all except proximal and distalmost well obscured by tufts of plumose setae, row flanked by several somewhat irregular rows of tubercles; ventral ridge adjacent to base of dactyl bearing 1 tubercle larger than most others on ventral surface of palm; dorsolateral tubercles conspicuously smaller and more depressed than those more mesially located on dorsal surface. Both fingers with low median longitudinal ridges dorsally and ventrally, ridges flanked

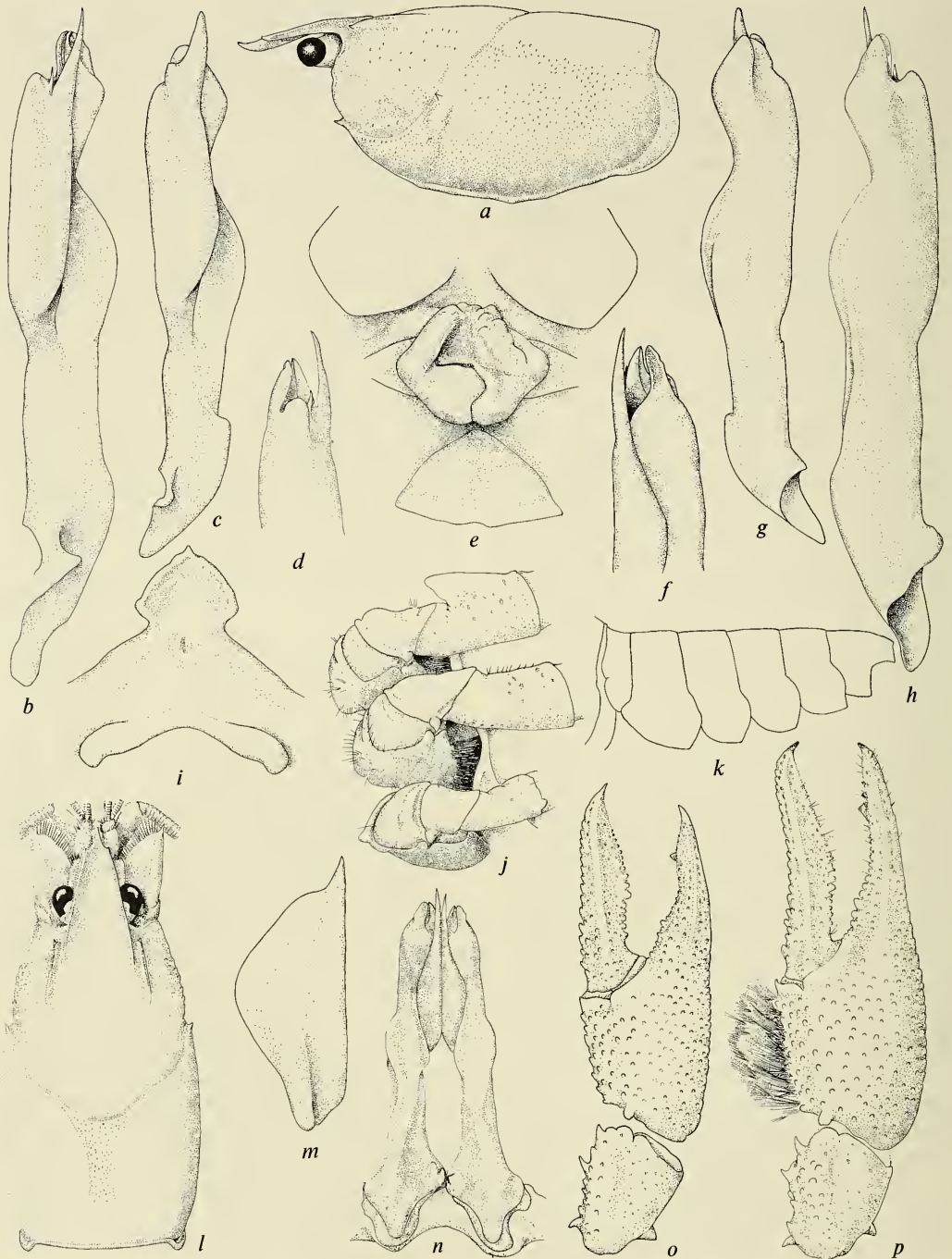


Fig. 1. *Procambarus (Girardiella) nigrocinctus* (all from holotype except c and g which are from morphotype, and e and o from allotype): a, Lateral view of carapace (rostrum broken, reconstructed on basis of other specimens); b, c, Mesial view of first pleopod; d, Cephalic view of apical part of first pleopod; e, Annulus ventralis and adjacent sternites; f, Caudal view of apical part of first pleopod; g, h, Lateral view of first pleopod; i, Epistome; j, Basal podomeres of third, fourth, and fifth pereopods; k, Lateral view of abdomen; l, Dorsal view of carapace (rostrum broken, reconstructed on basis of other specimens); m, Antennal scale; n, Caudal view of first pleopods; o, p, Dorsal view of distal podomeres of cheliped.

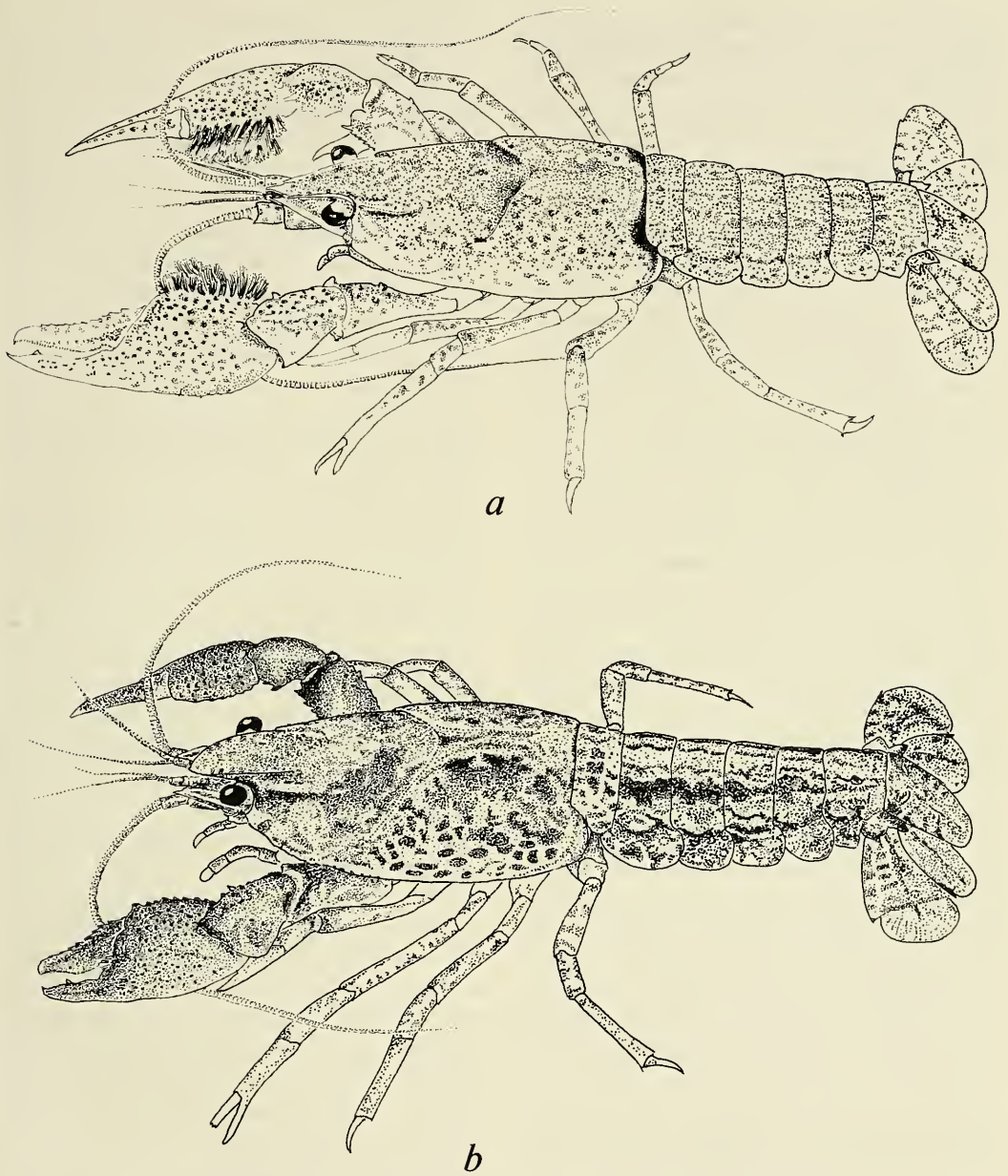


Fig. 2. Dorsolateral views of new crayfishes: a, *Procambarus (Girardiella) nigrocinctus*; b, *Procambarus (Girardiella) kensleyi*.

by tubercles along proximal half and by setiferous punctations along distal half. Opposable margin of fixed finger with row of 23 (left chela with 20) tubercles (more distal ones too small to be included in Fig. 1p), fifth from base largest, those distal to fifth decreasing in size to ultimate, which located

twice length of corneous tip of finger from apex; row of 3 (2 on left) strongly cornified tubercles borne more ventrally on opposable margin in distal third of finger; longitudinal band of minute denticles extending almost entire length, broadening in area between rows of tubercles in distal third of

finger; lateral margin with row of tubercles almost reaching midlength of finger. Opposable margin of dactyl with row of 17 (left with 12) tubercles, 7th (5th on left) from base largest, along proximal two-thirds of finger, few additional contiguous small tubercles on dorsal side of row, and distal to 17th (12th on left) tubercle, dorsal row of 4 and ventral one of 3 small tubercles continuing distally separated by band of minute denticles reaching base of corneous tip of finger; denticle band beginning at base of finger interrupted by principal tubercular row; mesial surface of finger with subserrate row of 17 (15 on left) tubercles.

Carpus of cheliped longer than broad with very shallow oblique furrow flanked mesially by squamous tubercles and laterally by scattered punctations; mesial surface with 2 acute tubercles somewhat larger than others and ventromesial triangular patch of tubercles with apex directed toward large, strongly acute tubercle on ventromesial distal margin of podomere; another similar strong tubercle on ventrodistal margin flanking articular condyle; otherwise ventral and lateral surfaces sparsely setose punctate.

Merus tuberculate dorsally with 2 strong, spiniform tubercles short distance proximal to distal margin; lateral, and most of mesial surfaces sparsely punctate, although distomesial surface with few small tubercles; ventral surface of podomere with mesial row of 15 tubercles and lateral one of 8 followed by oblique row of 4 joining distal ends of lateral and mesial rows; few additional tubercles present between and to the sides of the longitudinal rows. Strong spine present on distolateral angle. Ischium with row of 5 small tubercles ventromesially.

Hook on ischium of 3rd pereopod (Fig. 1j) simple, heavy, overreaching basioischial articulation, and opposed by weak, setiferous tubercle on corresponding basis. Coxa of 4th pereopod lacking caudomesial boss, that of 5th with small triangular one.

Sternum between 3rd, 4th, and 5th pereopods moderately deep; ventrolateral

margins with plumose setae obscuring much of 1st pleopods.

First pleopods (Fig. 1b, d, f, h, n) as described in "Diagnosis."

Uropods with both lobes of basal podomere bearing acute spines; mesial ramus with weak median carina but with well developed, distinctly-premarginal distomedian spine; distolateral spine strong.

Allotypic female.—Differing from holotype, other than in secondary sexual features, in following aspects: apex of rostrum reaching slightly beyond midlength of ultimate podomere of antennular peduncle; in respect to total carapace length, areola proportionately longer (32.0% of carapace length, 40.0% of postorbital carapace length) than in any other specimens available, but apical part of rostrum probably regenerated; cephalic section of telson with 2 fixed spines in each caudolateral corner; cephalic lobe of epistome subtriangular with irregular cephalolateral margins; 3rd maxilliped slightly overreaching basal podomere of antennule; mesial margin of palm of right chela (Fig. 1o) (left chela partly regenerated) lacking beard; opposable margin of fixed finger of chela with row of 11 tubercles, distalmost lying proximal to large tubercle situated ventral to level of row, denticles dispersed in single row; opposable margin of dactyl with row of 16 tubercles, 6th from base largest, 2nd row lacking, and denticles, for most part, arranged in single row, mesial surface with row of 15 tubercles, more distal ones not so well developed as in holotype; merus with ventromesial row of 13 tubercles, and 4 in row on ischium.

Annulus ventralis (Fig. 1e) as described in "Diagnosis." Preannular plate inconspicuous, deeply embedded in sternum, and consisting of narrow calcified arch, anteromedian part fusing with sternite XIII. Postannular sclerite subtriangular 1.7 times as broad as long and wider than, but only 0.7 as long as, annulus and bearing shallow, median longitudinal depression. First pleopod comparatively well developed, overreach-

ing cephalic margin of annulus when abdomen flexed.

Morphotypic male, form II.—Differing from holotype in following respects: apex of acumen reaching distal extremity of antennular peduncle; spines on body and on preoral appendages more strongly developed than in holotype and allotype; antennal scale broadest slightly proximal to midlength; beard on mesial surface of palm less well developed but clearly evident; opposable margin of fixed finger with row of 10 tubercles, 4th from base largest, corresponding margin of dactyl with row of 12 tubercles, 5th from base largest, and 2 more ventral tubercles near midlength of finger; mesial margin of dactyl with row of 13 tubercles; ventral surface of merus of cheliped with lateral row of 8 tubercles, mesial one of 12, and distal connecting row of 4; ischium of cheliped with ventromesial row of 4 tubercles; hooks on ischia of 3rd pereopods very small, tuberculiform. First pleopod (Fig. 1c, g) with shoulder on cephalodistal margin much weaker than that in holotype and not produced; mesial process much heavier than that in holotype, cephalic process not clearly distinguishable from cephalic rim partly encircling and forming part of bulbous central projection; caudal process well developed but, like other terminal elements, non-corneous.

Color notes.—Holotype (Fig. 2a): Predominant coloration tan with brown markings, most in form of small spots. Cephalic region of carapace tan with small brown spots and few pale ones along lateral rostral and postorbital ridges; latter with dark brown line extending along ventrolateral margin. Mandibular adductor region with complex patterns of fine spots forming paired semielliptical splotches abutting cervical groove. Thoracic region spotted like cephalic region and with conspicuous, paired, almost black, semielliptical splotches at posterior dorsolateral extremity; splotches narrowing and converging mesially into narrow transverse band. Abdo-

men similarly spotted but with darker pigments forming paired dorsolateral lines from first through basal part of 6th terga, and bases of pleura set off by scalloped sublinear series from which paler subtriangular patches extending laterally onto pleura; other spots scattered between lines and patches. Telson and uropods with anastomosing maculations exhibiting same color contrasts. Antennular and antennal peduncles and antennal scale spotted; flagella of both appendages tan. Third maxillipeds cream. Chelipeds similar in color to carapace (i.e., cream tan with brown spots) except tan reduced almost to cream over much of carpus, propodus, and dactyl; major tubercles on merus and carpus and those on mesial margin of palm and on fingers at least tipped with cream; those scattered over dorsum of merus, carpus, and palm very dark brown; both fingers fading from base distally to distinctly pinkish orange distal fourth. Setal tufts on mesial surface of palm tan. Second through 5th pereopods cream basally but with spots and splotches of grayish tan from merus through propodus.

Coloration of female differing in no remarkable way from that of male.

Type locality.—Jack Creek, a tributary of the Neches River, at State Route 94, about 3.0 mi (4.8 km) WSW of Lufkin Perimeter Route 287, Angelina County, Texas. There the creek was some 2 to 8 m wide, no more than 0.7 m deep, and flowed with a moderate current over a sandy and rocky bottom. The sometimes clear, weak-coffee colored water was slightly cloudy in November. Adult crayfish were found under the bridge among rocks and debris that had accumulated adjacent to the pilings. Just downstream from the bridge a stand of *Myriophyllum* was present in a sun-drenched area, and from the debris in this clump, a few juveniles were taken. Several burrows along the bank were examined, but no crayfish was found in them. Shading the creek were trees belonging to the genera *Liquidambar*, *Quercus*, *Pinus*, *Acer*, and *Salix*. The pop-

ulation in the area of the bridge is rather small, for only five adult specimens were collected on two visits to the locality, 16 April 1987 and 9 November 1987. Juveniles were far more common in April than in November.

Disposition of types.—The holotype, allotype, and morphotype (δ I, ♀ , δ II) are deposited in the National Museum of Natural History (Smithsonian Institution), nos. 219436, 219437, and 219438, respectively, as are the paratypes consisting of 1 δ I, 2 δ II, 3 ♀ , 22 j δ , and 30 j ♀ .

Size.—The largest specimen available is the allotypic female which has a carapace length of 42.2 (postorbital carapace length 33.4) mm despite the fact that the anterior part of the rostrum is apparently regenerated perhaps shorter than it would have been had it not been injured. The smaller of the two first form males has corresponding lengths of 37.3 and 28.9 mm. Oviparous females or ones carrying young have not been collected.

Range and specimens examined.—This crayfish has been collected in only five localities, all in the Neches River basin in Angelina and Jasper counties, Texas. Angelina County: (1) Type locality, 1 δ I, 1 δ II, 1 ♀ , 6 j δ , 18 j ♀ , 16 Apr 1987, GBH & HHH; 1 δ I, 1 ♀ , 1 j ♀ , 9 Nov 1987, BFK & HHH. (2) Jack Creek at Farm Road 2497, SW of Lufkin, 8 j δ , 6 j ♀ , 14 Apr 1987, GBH & HHH; 1 δ II, 2 ♀ , 1 j δ , 1 j ♀ , 9 Nov 1987, BFK & HHH. (3) Moccasin Creek at Farm Rd 2497, 4.9 mi (7.8 km) SE of jct with St Rte 94, 1 δ II, 6 j δ , 3 j ♀ , 9 Nov 1987 BFK & HHH. (4) Pool in roadside ditch on Farm Rd 2407, 1.2 mi (1.9 km) SE of intersection with St Rte 94, 1 j ♀ . 9 Nov 1987, BFK, HHH. Jasper County: (5) Sand-bottomed creek at St Rte 63, 1.1 mi (1.8 km) SE of Angelina River, 1 j δ , 11 Nov 1987, BFK & HHH. Almost certainly Reimer's "*Procambarus* species F" is conspecific with this crayfish (unfortunately, these specimens have not been available to me); he reported its presence in Anderson County : (6) 4.1

mi E of Slocum. Nacodoches County: (6) 5 mi E of Nacogoches; (7) 4 or 5 mi NW of Nacodoches; (8) 9 mi W of Nacogoches; (10) 2.5 mi SW of Garrison, Polk County: (11) 2 mi S of Corrigan. Smith County: (12) 3.5 mi N of Troup. Shelby County: (13) 13 mi N, 2 mi W of San Augustine.

Variations.—With so few adult specimens, and these from nearby localities, it is not surprising that the range of variation noted among them seems very small. One of the most conspicuous variations occurs in the relative development of the beard on the mesial margin of the palm of the chela: it is much the longest and densest in first form males, but it appears in the young by the time they have attained a carapace length of 10 mm. It becomes more obvious with succeeding molts in both sexes, and in at least some juvenile males approaching the molt that will take them into first form, the setal tufts are little, if any, better developed than they are in adult females. In some of the latter, the beard is reduced to a few small patches of setae that scarcely rise above the level of the adjacent tubercles, as occurs in the allotype. The chief differences noted in the rostrum seem to be associated with injury, primarily the loss of part or all of the acumen, and in several specimens, including both first form males, the acumen is either absent or has obviously been broken and regenerated, its tip not attaining the distal extremity of the antennular peduncle. The areola in specimens with carapace lengths of at least 27.8 mm ranges from 4.5 to 6.2 times as long as broad and comprises from 28.5 to 32.0% of the total length of the carapace (37.4 to 40.9% of postorbital length). The spines on the carapace and chelipeds are almost always well developed, although occasionally one or more may be shorter than the average (asymmetry in degree of development suggests that some reductions might well be associated with injury and regeneration). The spines in the caudolateral corners of the cephalic section of the telson vary in size and number: there

may be two, three, or four in each corner, but only one, that immediately mesial to the fixed lateral spine, in each corner is movable. The differences noted in the secondary sexual features deserve no comment.

Relationships.—The color pattern, the bearded chelae, the comparatively broad areola, and the proximity of the range to that of *Procambarus (Girardiella) tulaneii* Penn, 1953, attest to the assumed close relationship existing between *P. (G.) nigrocinctus* and that species. They are both “speckled” and, although less well defined in *tulaneii*, corresponding dark areas (line on lateral flank of postorbital ridges; large area over and adjacent to the mandibular adductor region; and parts of the dark band on the caudal margin of the carapace) are comparable. The areolae of the primary types of *P. tulaneii*, according to Penn’s measurements, range from 7.8 to 9.0 times as long as wide, in all of the available adults of *P. nigrocinctus*, from 4.5 to 6.2. The ranges of the two are contiguous, for *P. tulaneii* has been found as far west in Louisiana as the Sabine River basin, which parallels the Neches watershed immediately to the west. Insofar as is known, however, their ranges are allopatric.

The presence of marginal spines on the rostrum, well developed cervical spines, a distinct dark band at the caudal margin of the carapace, and a first pleopod of the male in which the central projection does not overreach the lamelliform lobe of the caudal process will serve to distinguish *P. (G.) nigrocinctus* from all other members of the subgenus *Girardiella*.

Ecological note.—All except one of the specimens available to us were taken from streams. The single juvenile female obtained at locality 4, however, came from what appears to be a permanent roadside pool that appeared to be distant from a body of flowing water.

Etymology.—Niger (L.) = black + Cinctus (L.) = girdle; alluding to the narrow black

Table 2.—Measurements (mm) of *Procambarus (G.) kensleyi*.

	Holotype	Allotype	Morphotype
Carapace:			
Entire length	31.8	33.5	31.3
Postorbital length	25.5	27.0	24.9
Areola:			
Width	2.1	2.4	1.6
Length	10.2	10.3	9.8
Rostrum:			
Width	5.2	6.3	5.2
Length	7.3	7.5	7.7
Right chela:			
Length, palm mesial margin	8.0	6.3	5.2
Palm width	8.3	8.2	6.6
Length, lateral margin	23.3	20.0	18.6
Dactyl length	13.4	11.7	11.0
Abdomen:			
Width	13.5	14.8	12.5
Length	32.8	37.2	31.7

band across the caudal margin of the carapace.

Associates.—Collected with this crayfish in one or more localities were: *Procambarus (Ortmannicus) a. acutus* (Girard, 1852), *P. (Girardiella) curdi* Reimer, 1975, *P. (Scapulicambarus) clarkii* (Girard, 1852), *P. (O.) nechesae* n. sp., and *Fallicambarus (C.) fodiens* (Cottle, 1863).

Procambarus (Girardiella) kensleyi,
new species

Figs. 2b, 3, Table 2

Procambarus species F.—Reimer, 1969:73
[in part?].

Diagnosis.—Body pigmented, eyes well developed. Rostrum without marginal spines, lacking median carina. Carapace without cervical spine. Areola 4.0 to 6.2 (mean 5.1 ± 0.81) times as long as broad and constituting 30.4 to 34.7 (mean 32.2 ± 1.26) percent of total length of carapace (36.9

to 42.9, mean 40.1 ± 1.63 , percent of post-orbital carapace length). Suborbital angle obtuse; hepatic area weakly tuberculate; branchiostegal spine rather weak. Antennal scale about 2.2 times as long as broad, widest slightly distal to midlength. Mesial surface of chela not bearded, ventral surface tuberculate, tubercles present along proximal half of ventral surface of dactyl. Ischium of third pereopod in first form male with simple hook overreaching basioischial articulation; hook not opposed by tubercle on corresponding basis; coxa of fourth pereopod lacking caudomesial boss. First pleopods of first form male reaching coxae of third pereopods, symmetrical, bearing proximomesial spur, and subangular shoulder at base of terminal elements lacking lateral subterminal setae; setae on caudoproximal ridge directed caudally, not flared; terminal elements (all sclerotized at least distally) consisting of (1) straight, tapering, subspiculiform, distally-directed mesial process; (2) very short, acute, distally-directed cephalic process; (3) strong, cornified, acute, cephalocaudally-flattened, distally-disposed central projection not overreaching (4) prominent, distally-cornified, flattened, obliquely-positioned caudal element, latter consisting of caudomesially excavate lamelliform lobe with small digitiform prominence situated in caudomesial concavity. Lamelliform lobe and central projection reaching almost same level distally. Female with annulus ventralis freely movable, about 1.2 times as broad as long, and subrhomboidal (but tilted) in outline; moderately deep cephalomedian trough, flanked by smooth to tuberculate ridges, broadening posteriorly, dextral wall flaring more strongly than sinistral one; sinus originating in caudodextral part of trough, forming symmetrical loop caudodextrally over tongue and fossa, then turning caudosinistrally across median line before curving caudally and slightly dextrally and ending just anterior to caudal margin of annulus. Preannular plate poorly developed; first pleopods present.

Holotypic male, form I.—Cephalothorax (Fig. 2b, 3a, l) subcylindrical. Second segment of abdomen distinctly narrower than thorax (13.5 and 15.9 mm). Areola 4.9 times as long as broad and with room for 4 or 5 punctations across narrowest part. Cephalic section of carapace 2.1 times as long as areola, latter comprising 32.1% of total length of carapace (40.0% of postorbital carapace length). Surface of carapace punctate dorsally, hepatic area mostly tuberculate and lateral and ventrolateral parts of branchiostegites granulate, anteroventral branchiostegal region tuberculate. Rostrum broad, gradually tapering from base to level of distal extremity of proximal podomere of antennule, anteriorly contracting more rapidly to apex, which reaching almost midlength of ultimate podomere of antennular peduncle; margins not thickened and without spines or tubercles; dorsal surface, lacking median carina, concave with punctations scattered between prominent submarginal rows. Subrostral ridges weak and not evident in dorsal aspect. Suborbital angle inconspicuous and obtuse. Branchiostegal spine moderately well developed; cervical spine represented by small tubercle.

Abdomen (Figs. 2b, 3k) shorter than carapace. Cephalic section of telson with 2 spines in each caudolateral corner, lateral one fixed. Cephalic lobe of epistome (Fig. 3i) subtriangular with irregularly crenulate anterolateral margins; main body of epistome with distinct fovea. Ventral surface of proximal podomere of antennular peduncle with small spine near midlength, mesial margin of peduncle with plumose setae, especially 2 more distal podomeres. Antennal peduncle with small spine on both basis and ischium, distal 3 podomeres bearing prominent mesial fringe of plumose setae; flagellum reaching fourth abdominal tergum. Antennal scale (Fig. 3m) about 2.2 times as long as broad, widest slightly distal to midlength; greatest width of lamellar area about 2 times that of thickened lateral part.

Third maxilliped almost reaching distal end of proximal podomere of antennule;

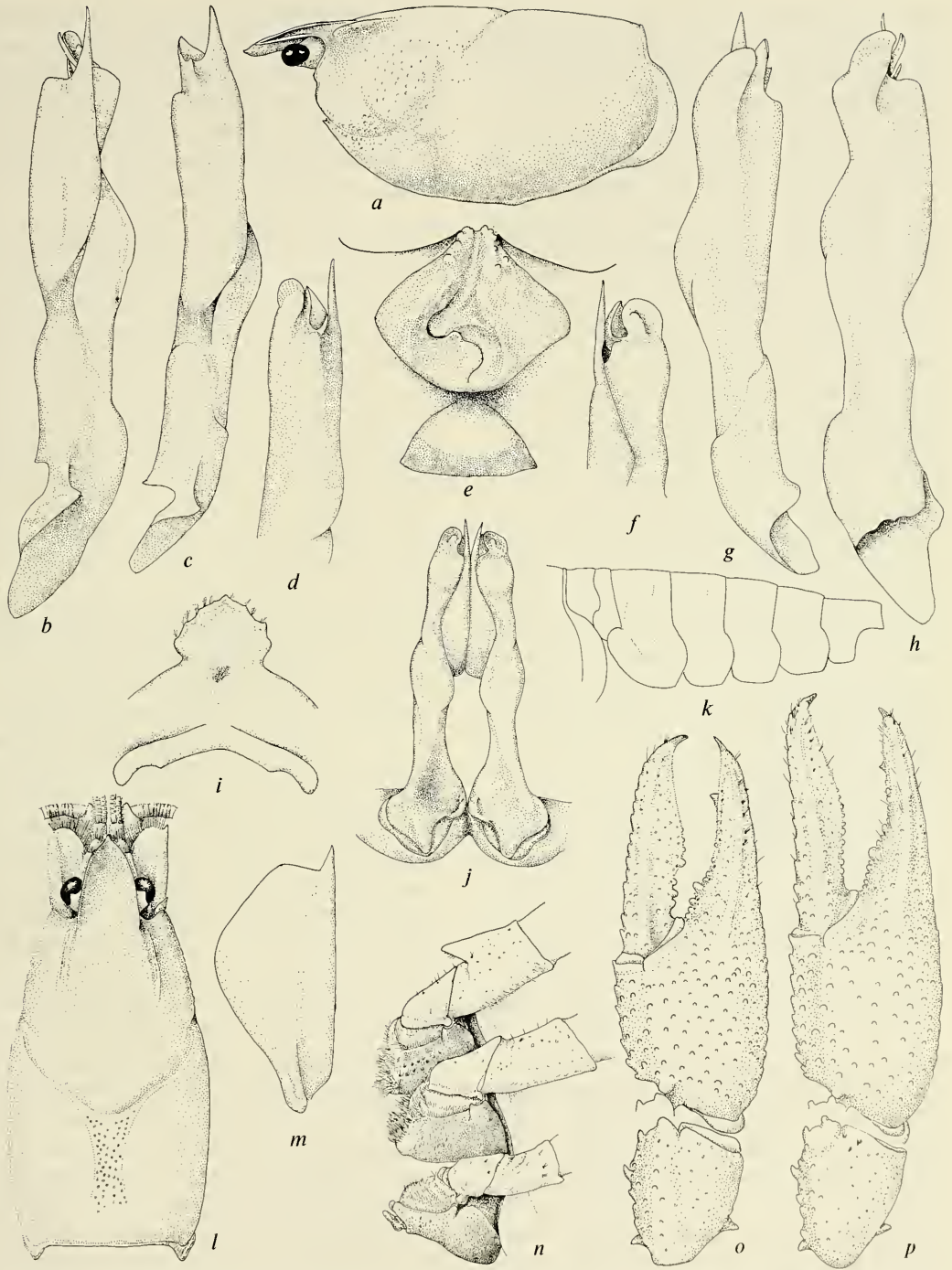


Fig. 3. *Procambarus (Girardiella) kensleyi* (all from holotype except c and g from morphotype, e and o from allotype, and j from topotypic first form male): a, Lateral view of carapace; b, c, Mesial view of first pleopod; d, Cephalic view of distal part of first pleopod; e, Annulus ventralis and adjacent sclerites; f, Caudal view of distal part of first pleopod; g, h, Lateral view of first pleopod; i, Epistome; j, Caudal view of first pleopods; k, Lateral view of abdomen; l, Dorsal view of carapace; m, Antennal scale; n, Basal podomeres of third, fourth, and fifth pereopods; o, p, Dorsal view of distal podomeres of cheliped.

ventral surfaces of ischium and merus studded with dense mat of plumose setae; lateral surface of all except distalmost part of merus hidden in lateral aspect.

Right chela (fig. 3p) (left regenerated) subovate in cross section, moderately depressed; palm slightly broader than length of mesial margin; latter slightly more than one-third total length of chela; entire palm studded with tubercles; 7 present in each of 3 mesialmost rows; ventral ridge opposite base of dactyl with 1 tubercle larger than others on ventral surface. Both fingers with low median longitudinal ridges dorsally and ventrally, ridges flanked by tubercles proximally and setiferous punctations distally. Opposable margin of fixed finger with row of 17 small tubercles along proximal three-fourths of finger, sixth from base largest (more distal ones very small); larger ("locking") tubercle present below distalmost tubercle of row; band of minute denticles extending from base of finger to base of corneous tip between and distal to tubercles; lateral margin with row of tubercles reaching midlength of finger (not visible in Fig 3p). Opposable margin of dactyl with row of 12 comparatively small tubercles, fifth from base largest, along proximal two-thirds of finger; band of minute denticles extending from base of finger to base of corneous tip between and distal to tubercles; mesial surface of finger with row of 12 tubercles, distalmost just proximal to corneous tip.

Carpus of cheliped longer than broad with shallow oblique furrow flanked mesially by tubercles and few punctations and laterally by widely spaced punctations; mesial surface with 2 tubercles larger than others, one just distal to midlength and other at dorsodistal angle, 9 additional ones present in proximal half; ventral surface with few squamous tubercles and punctations proximal to 3 subacute tubercles on distal margin.

Merus tuberculate dorsally with 2 strong spiniform tubercles near distal margin; mesial surface with few tubercles near distal extremity, otherwise it and lateral surface

with scattered punctations; ventral surface with mesial row of 14 tubercles, lateral one of 10, and oblique distal row of 4; tufts of short plumose setae present between rows; short, heavy, spiniform tubercle on distolateral extremity. Ischium with row of 4 tubercles ventromesially and another of 3 dorsally.

Hook on ischium of third pereopod (Fig. 3n) simple and overreaching basioischial articulation, not opposed by tubercles on corresponding basis. Coxa of fourth pereopod without caudomesial boss, that of fifth with small rounded one.

Sternum between third, fourth, and fifth pereopods moderately deep, ventral marginal fringe of plumose setae concealing much of first pleopods.

First pleopods (Fig. 3b, d, f, h, j) as described in "Diagnosis."

Uropods with both lobes of basal podomere bearing acute spines; mesial ramus with premarginal distomedian spine at end of keel and strong lateral spine.

Allotypic female.—Differing from holotype, other than in secondary sexual features, in following respects: areola 30.7% of carapace length (38.1% of postorbital carapace length); rostrum reaching distal end of penultimate podomere of antennular peduncle; flagellum of antenna reaching fifth abdominal tergum; chela (Fig. 3o) with 6 tubercles present in mesialmost row on palm, 5 in adjacent dorsal row and 6 in adjacent ventral row; opposable margin of fixed finger with row of 9 tubercles, fourth from base largest; corresponding margin of dactyl with 9; opposable margins of both fingers with single longitudinal row of minute denticles; mesialmost of 3 tubercles on ventral surface of carpus of cheliped situated more dorsally; merus with ventromesial row of 15 tubercles, ventrolateral one of 11, and oblique distal row of 3; only 2 tubercles present on dorsal margin of ischium.

Annulus ventralis (Fig. 3e) as described in "Diagnosis."

Morphotypic male, form II.—Differing

from holotype in following respects: areola 6.1 times as long as broad and consisting of 31.3% of length of carapace, 39.3% of post-orbital length; abdomen slightly longer than carapace; cephalic section of telson with 3 (right) or 4 (left) spines in each caudolateral corner; anterolateral margins of cephalic lobe of epistome almost smooth; antennal flagellum reaching base of telson; setae on third maxilliped less dense and most of merus visible in lateral aspect; row on mesial margin of palm of chela flanked by row of 6 tubercles dorsally and one of 7 ventrally; opposable margin of fixed finger with row of 11 tubercles, fourth from base largest; corresponding margin of dactyl with row of 13 tubercles; denticles on both fingers arranged in single row; carpus with tubercles situated more similar to those in allotype; ventromesial angle of merus with row of 15 tubercles, 8 in lateral row, and 4 in oblique row; ischium with ventromesial row of 5 tubercles; hook on ischium of third pereopod and boss on coxa of fifth markedly reduced; setae on ventrolateral margins of sternites XII and XIII much less well developed.

First pleopods (Fig. 3c, g) with reduced setation; terminal elements disposed as in holotype (cephalic process slightly more posteriomesially situated), and while shorter, more stocky and none corneous.

Color notes.—(Based on recently molted first form male from Trinity County, Texas; see Fig. 2b for pattern.) Basic colors dark tan with reddish brown markings. Rostrum dark tan with few small brown splotches, some of which anastomosing in basal area; postorbital ridges with brown stripe flanking ventrolateral border and merging with anastomosing splotches forming anterior part of irregular longitudinal stripe; lateral part of cephalic region with mosaic dark brown pattern. Suborbital angle encompassed by cream-colored splotch extending over antennal and mandibular regions. Thoracic region with ill-defined, irregular stripe dorsolaterally and with distinctive spotted pattern laterally (spots and back-

ground fading ventrally); areola mostly tan but with dark branchiocardiac grooves and submedian elongate spot anteriorly. Caudal ridge almost black; caudal flange gray. Abdomen with tan dorsomedian stripe from first to anterior half of sixth abdominal tergum; stripe flanked by irregular, very narrow brown stripe, and it, in turn, by broader dorsolateral ones continuous with irregular ones on branchiostegites; third pair of brown stripes formed by ventrally convex arcs across bases of pleura, these flanked dorsally and ventrally by mosaic of pale anastomosing splotches. Telson and uropods all tan with light reddish brown and cream spots; proximal podomere of uropods edged in dark brown, spines on telson and uropodal rami also dark brown. Antennular and antennal peduncles and antennal scale with dark brown margins; flagella light brown with olive suffusion distally. Dorsum of chelipeds from merus distally tan with dark brown to black tubercles, ventral surface mostly pinkish cream to pinkish tan; tips of fingers purplish. Remaining pereopods light pinkish tan with darker tan to brown splotches dorsally; distal part of merus and carpus darker than more proximal and distal podomeres, which pinkish cream dorsally and ventrally. Setal tufts on third maxillipeds cream.

Type locality.—Roadside ditch on gentle slope 4.6 mi (7.4 km) NW of US Highway 59 on Farm Road 2497, Angelina County, Texas. There the crayfish were collected from simple burrows 0.5 to 0.8 m deep and topped by chimneys eight to 25 cm tall. The soil was a sandy clay supporting grasses and sedges. Dominant among the trees in the adjacent woods were *Liriodendron tulipifera* and members of the genera *Pinus* and *Quercus*.

Disposition of types.—The holotype, allotype, and morphotype (♂ I, ♀, ♂ II) are deposited in the National Museum of Natural History (Smithsonian Institution), nos. 219772, 219973, and 219774, respectively, as are the paratypes consisting of 4 ♂ I, 3 ♂ II, 8 ♀, 1 j♂, and 3 j♀.

Size.—The largest specimen available is a female from Tyler County, Texas, having a carapace length of 40.9 mm (postorbital length 32.8 mm). The largest and smallest first form males have corresponding lengths of 36.3 (28.9) mm and 30.6 (25.2) mm. Measurements are not available for females carrying eggs or young, neither of which has been collected.

Range and specimens examined.—This crayfish has been found in eleven localities in eastern Texas as follows (The specimens in those collections preceded by asterisks are excluded from the type series.): Angelina County: (1) Type locality, 2 ♂ I, 2 ♂ II, 3 ♀, 1 j♀, 14 Apr 1987, GBH & HHH. *(2) Roadside ditch 5.6 mi (9.0 km) NE of US Hwy 59 on Farm Rd 2497, 1 j♂, 2 j♀, 14 Apr 1987, GBH & HHH. Jasper County: (3) Roadside ditch on St Rte 63, 0.7 mi (1.1 km) NW of Farm Rd 255, 1 ♂ I, 2 ♂ II (one molted to form I on 10 Feb 1988), 2 ♀, 11 Nov 1987, BFK & HHH. (4) Roadside ditch on US Hwy 190, 1.5 mi (2.4 km) E of County Courthouse, 1 ♀, 12 Nov 1987, BFK & HHH. Newton County: *(5) Pool in roadside ditch 6.3 mi (10.1 km) NW of Newton on US Hwy 190, 13 juv, 11 Nov 1987, BFK & HHH. (6) Roadside ditch 2.7 mi (4.3 km) NW of Newton on US Hwy 190, 1 ♂ II, 1 j♂, 1 j♀, 11 Nov 1987, BFK & HHH. Panola County: *(7) Roadside ditch 9 mi (14.4 km) S of Carthage on US Hwy 96, 2 j♂, 17 Apr 1987, GBH & HHH (tentatively assigned to this species). San Augustine County: (8) Burrow in creek bank 1.7 mi (2.7 km) NE of San Augustine on Farm Rd 353, 1 ♀, 8 Nov 1987, BFK & HHH. Trinity County: (9) Burrow in creek bank on Farm Rd 2262 9.0 mi (14.4 km) SW of Farm Rd 357, 1 ♂ II (molted to form I in laboratory), 1 j♀, 14 Nov 1987, BFK & HHH. Tyler County: (10) Floodplain of Horsepen Creek on US Hwy 190, about 1.5 mi (2.4 km) E of Polk Co line, 1 ♀, 13 Nov 1987, BFK & HHH. (11) Floodplain of Big Cypress Creek on US Hwy 190, about 4 mi (6.4 km) E of Polk Co line, 1 ♀, 12 Nov 1987, BFK & HHH.

Should Reimer's "*Pocambarus species G*" prove to be conspecific with this crayfish, a number of localities cited by him expands the range of the species into western Louisiana and southwestern Arkansas. The identity of specimens from the localities offered by him should be confirmed.

Variations.—With so few specimens available from all of the localities, there is no way to determine whether the few variations noted are individual ones or typical of the populations of which they were members. No attempt is therefore made to note in which locality/ies these features were exhibited. The antennal scale may be broadest at midlength or slightly more distally; the third maxillipeds are all hirsute, but some decidedly more so than others; the suborbital angle varies from being almost obsolete to almost acute, but in none of the specimens is it prominent; differences noted in the first pleopod of the first form males include reduction or absence of a proximal mesial spur, a reduction in the cephalic process that renders it a virtual rudiment, and in one specimen the central projection slightly surpasses the caudal process distally; the annulus ventralis exhibits much variability in the nature of the ridges bordering the cephalomedian trough: they may be smooth and quite approximate so that their opposing slopes are almost vertical or, like the allotype (Fig. 3e), they may be tuberculate with their crests more widely separated. While there are variations in the numbers of tubercles elsewhere and, to some extent, in their distribution, most fall within the range cited for the primary types. Tubercles on the dorsolateral margin of the ischium of the third maxilliped are absent in many crayfishes but here range in number from 2 to 5.

Relationships.—*Procambarus (G.) kensleyi* has its closest affinities with *P. (G.) parasimulans* Hobbs & Robison (1982). In both of them the areola is broad (no more than nine times as long as wide) and short (constituting a maximum of 35% of the Cara-

pace length), the opposable margin of the dactyl of the cheliped lacks a well defined excision in the basal third, the dorsolateral surface of the palm of the chela is tuberculate, the central projection of the first pleopod of the first form male neither clearly overreaches nor projects laterally beyond the caudal process. They differ in that in *P. (S.) kensleyi* the areola is more densely punctate, the rostrum is almost always more tapering, the mesial margin of the antennular peduncle and the ventral and ventrolateral surfaces of the third maxilliped are strongly hirsute, the cephalic process of the first pleopod does not extend beyond mid-length of the central projection which extends as far distally as the caudal element, and the latter is less tapering.

Ecological notes.—Even though all of the adult specimens belonging to this species that have been collected came from burrows, I am reluctant to state that it is a primary burrower, largely because of the simplicity of their domiciles which consist of a single subvertical, slightly sloping or loosely spiraling shaft that leads to a very slight enlargement at depths of 0.6 to 1.8 m. In most of the localities, the soil consisted of clay or sandy clay overlain by sand, occasionally by as much as 30 cm. Whereas no adults were found in open water, perhaps this reflects the habitats (burrows) selected by the collectors rather than the habitat distribution of the crayfish. More frequently than not, a broad, short areola, such as that possessed by this crayfish, is that of a dweller of well areated streams. The lack of a reduction in the abdomen also suggests that it frequents open water.

Some burrowing crayfishes can be enticed to the air-water interface in burrows (Hobbs, 1981:31), but not one of the specimens available could be lured from the fundus of its single shaft which lacked even one conspicuous chamber.

Etymology.—This crayfish is named in honor of my friend and colleague Brian F. Kensley whose assistance in collecting many

Table 3.—Measurements (mm) of *Procambarus (O.) nechesae*.

	Holotype	Allotype	Morphotype
Carapace:			
Entire length	32.6	40.6	32.6
Postorbital length	25.5	20.9	24.7
Width	16.3	19.5	16.0
Height	16.0	19.0	15.1
Areola:			
Width	1.4	1.3	1.5
Length	10.4	12.9	9.6
Rostrum:			
Width	5.6	6.9	5.6
Length	8.0	11.3	8.9
Right chela:			
Length, palm mesial margin	11.4	8.0*	7.9*
Palm width	8.2	7.5*	6.3*
Length, lateral margin	31.8	24.0*	23.8*
Dactyl length	17.5	14.1*	13.7*
Abdomen:			
Width	13.7	17.3	13.0
Length	33.7	43.3	33.8

* Left chela.

of the crayfishes reported here was invaluable.

Associates.—Co-existing with this crayfish in one or more localities were members of: *Cambarus (L.) diogenes*, *C. (L.) ludovicianus*, *Fallicambarus (C.) fodiens*, *Procambarus (G.) curdi*, *Faxonella beyeri*, *Procambarus (O.) acutus acutus* (Girard), and *P. (Pe.) dupratzi* Penn (1953).

Procambarus (Ortmannicus)
acutus acutus (Girard)

Cambarus acutus Girard, 1852:91.

Procambarus (Ortmannicus) acutus acutus.—Hobbs, 1972:9.

New records.—Angelina Co.: 3.5 mi (5.6 km) NW of US Hwy 59 on Farm Rd 2497, 1 ♂ II, 1 j♂, 14 Apr 1987, GBH & HHH. 4.2 mi (6.7 km) NW of US Hwy 59 on Farm Rd 2497, 1 ♂ I, 3 j♂, 2 j♀, 14 Apr 1987, GBH

& HHH. trib. Moccasin Creek at Farm Rd 2497, 4.9 mi (7.8 km) SE of St Rte 94, 1 ♂ II, 9 Nov 1987, BFK & HHH. 1.3 mi (2.1 km) W of Shawnee Creek on Farm Rd 1818, 3 j♂, 1 j♀, 11 Nov 1987, BFK & HHH. Jasper Co.: 8.7 mi (13.9 km) NW of US Hwy 190 on St Rte 63, 1 j♂, 17 Apr 1987, GBH & HHH. 9.2 mi (14.7 km) NW of US Hwy 190 on St Rte 63, 3 ♂ II, 2 ♀, 17 Apr 1987, GBH & HHH. Newton Co.: 6.3 mi (10.1 km) NW of Newton on US Hwy 190, 1 j♂, 2 j♀, 11 Nov 1987, BFK & HHH. Polk Co.: 7 mi (11.2 km) W of US Hwy 287 off Farm Rd 1745 (David Farm), 2 ♂ II, 4 j♂, 4 j♀, 12 Nov 1987, J. David, RA, BFK, & HHH. Trinity Co.: 4 mi (6.4 km) SW of Farm Rd 357 on Rd 2262, 1 j♂, 1 j♀, 14 Nov 1987, BFK & HHH.

Remarks.—The specimens cited here were taken from sluggish streams, roadside pools, and from burrows consisting of single, sub-vertical shafts.

Procambarus (Ortmannicus) nechesae,
new species
Fig. 4, Table 3

Diagnosis.—Body pigmented, eyes well developed. Rostrum of adults with or without marginal spines but lacking median carina. Carapace with small cervical spine or tubercle. Areola 7.3 to 10.9 (mean 8.8 ± 1.20) times as long as wide and constituting 29.1 to 32.4 (mean 30.9 ± 1.03) percent of total length of carapace (38.0 to 42.3, mean 40.8 ± 1.20 percent of postorbital length). Suborbital angle very weak and obtuse; postorbital ridges with cephalic spine or tubercle sometimes abraded; hepatic area weakly tuberculate; branchiostegal spine small to vestigial. Antennal scale little more than twice as long as broad, widest at about midlength. Ischia of third and fourth pereopods with simple hooks, hooks of third distinctly overreaching basioischial articulation and lacking opposing tubercle on basis, that of fourth almost reaching articulation and opposed by strong tubercle on basis; coxa of fourth pereopod with strong

caudomesial boss, that of fifth much smaller and flattened. First pleopod of first form male reaching coxa of third pereopod, asymmetrical, provided distolaterally with rounded prominence (caudal knob) bearing conspicuous tuft of subapical setae; terminal elements consisting of (1) mesial process tapering from base to acute tip, directed caudolaterally and extending distally to about tip of caudal process; (2) acute cephalic process directed caudally, hooding (3) beaklike central projection which also directed caudally; and (4) caudal process, arising from caudolateral extremity of shaft, bladellike with acute tip and directed caudodistally. Annulus ventralis about twice as broad as long, with nearly straight caudal margin and strongly arched cephalically; sinuous sinus arising near cephalic margin, progressing caudosinistrally in cephalic third of annulus before turning caudally and finally caudodextrally ending on prominent protruding submedian tongue-like prominence. Sternum immediately anterior to annulus with low tubercles flanking median line. Unadorned postannular sclerite subtriangular, almost two-thirds as broad as annulus. First pleopod present in female.

Holotypic male, form I.—Cephalothorax (Fig. 4a, k) subcylindrical in section. Abdomen narrower than thorax (16.7 and 20.5 mm). Greatest width of carapace slightly greater than height at caudodorsal margin of cervical groove. Areola 8.3 times longer than wide with 1 or 2 punctations in narrowest part. Cephalic section of carapace about 2.1 times as long as areola, length of latter 31.9% of entire length of carapace (40.8% of postorbital carapace length). Surface of carapace punctate dorsally, granulate laterally. Rostrum slightly deflected ventrally with slender converging margins, its acute apex reaching slightly beyond midlength of penultimate podomere of antennular peduncle; margins neither thickened nor provided with spines or tubercles, faintly contracted at base of short acumen; dorsal surface concave with many fine setiferous

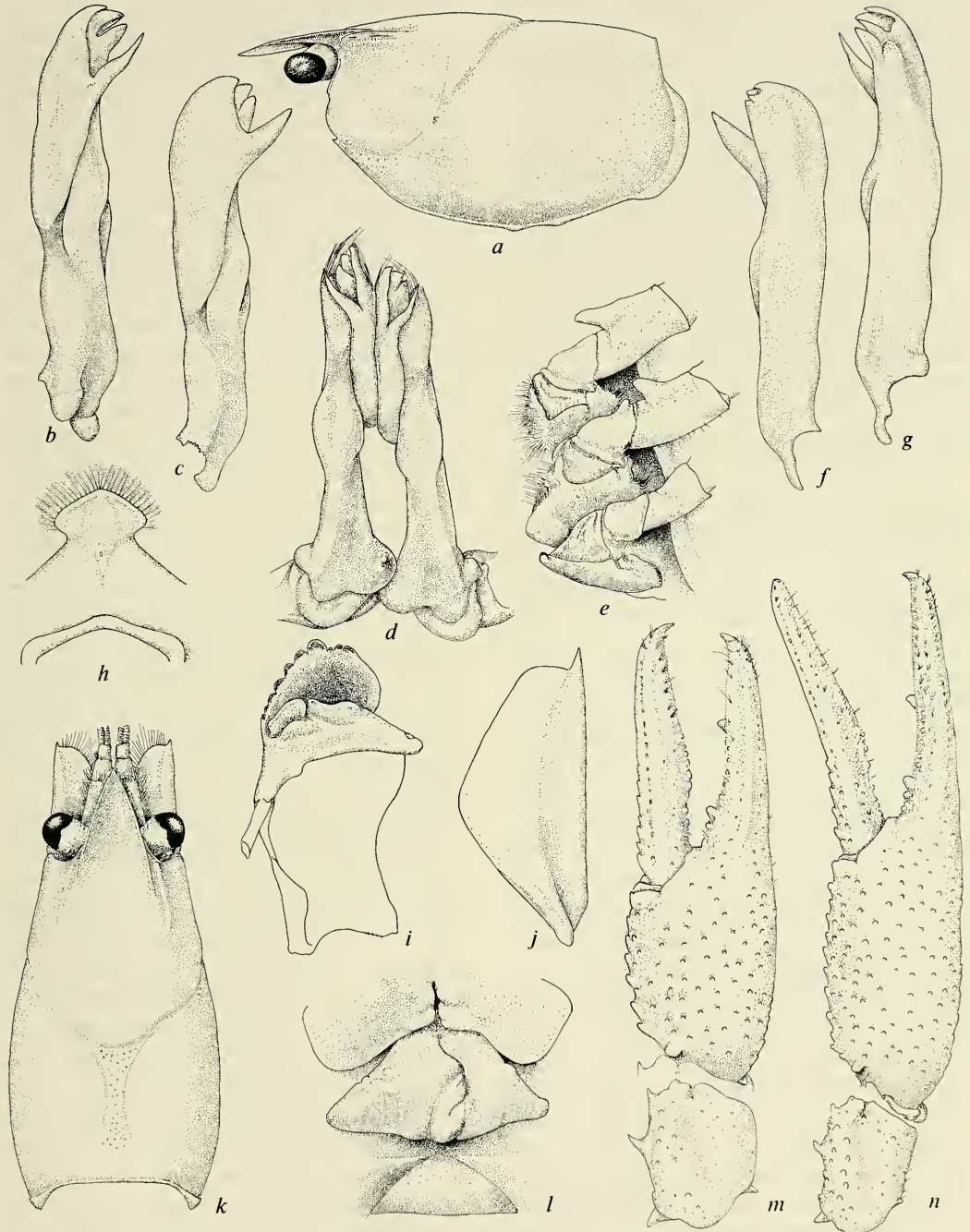


Fig. 4. *Procambarus (Ortmannicus) nechesae* (all from paratypic male, form I, except a and k from holotype, c and f from morphotype, l from allotype, and m from paratypic female): a, Lateral view of carapace; b, c, Mesial view of first pleopod; d, Caudal view of first pleopods; e, Basal podomeres of third, fourth, and fifth pereopods; f, g, Lateral view of first pleopod; h, Epistome; i, Adductor face of mandible; j, Antennal scale; k, Dorsal view of carapace; l, Annulus ventralis; m, n, Dorsal view of distal podomeres of cheliped.

punctations. Subrostral ridge evident in dorsal aspect for only short distance anterior to caudal margin of orbit. Postorbital ridge well developed, grooved dorsolaterally and bearing small tubercle at cephalic extremity. Suborbital angle very small and obtuse. Branchiostegal spine also small. Cervical spine represented by small tubercle.

Abdomen and carapace subequal in length. Pleura of third through fifth segments very broadly rounded, almost truncate ventrally but lacking posteroventral angles. Cephalic section of telson with 2 spines in each caudolateral corner, lateral ones immovable; caudal margin of caudal section with shallow median excavation. Cephalic lobe of epistome (like Fig. 4h) broadly triangular with slightly elevated cephalolateral margins heavily fringed with plumose setae, central area convex; distinct anteromedian fovea present on main body. Ventral surface of proximal podomere of antennular peduncle with spine at midlength. Antenna with comparatively weak spiniform tubercles on basis and ischium; flagellum extending almost to end of telson. Antennal scale (like Fig. 4j) almost 2.5 times as long as broad, widest at about midlength; greatest width of lamella about 1.8 times width of thickened lateral part.

Mandible (like Fig. 4i) as illustrated. Third maxilliped extending cephalically to base of penultimate podomere of antennule; ischium not produced distolaterally, its ventral surface studded with plumose setae.

Right chela (like Fig. 4n) subovate in cross section, not strongly depressed. Mesial surface of palm with row of 8 tubercles subtended by additional rows of more squamous ones dorsally and ventrally; tubercles present over all except ventrolateral part of palm and also present on basal parts of both fingers. Both fingers with low, rounded longitudinal ridges dorsally and ventrally, all poorly defined except for being flanked by rows of setiferous punctations. Opposable margin of fixed finger with dorsal row of 9

(10 on left) tubercles, third from base largest, on proximal half of finger, and ventral row of 6, fifth much larger than others, in middle third of finger; lateral margin with row of setiferous punctations. Opposable margin of dactyl with dorsal row of 11 tubercles in proximal half and ventral row of 13 (8 and 18, respectively, on left); mesial margin with row of 5 (7 on left) tubercles proximally followed by row of setiferous punctations. Mesial surface of dactyl with subserrate row of tubercles along proximal two-fifths. Carpus of cheliped longer than broad with distinct oblique furrow dorsally, tuberculate mesially and dorsomesially; mesial surface with 3 tubercles somewhat larger than others: 1 proximally, 1 near midlength, and another distally; ventral surface with usual 2 tubercles on distal margin, otherwise setiferous.

Merus tuberculate dorsally, distomesially, and ventrally; 1 premarginal tubercle larger than others on dorsodistal surface; ventral surface with mesial row of 16 tubercles and lateral one of 11, 3 forming oblique distal row joining lateral and mesial rows. Ischium with ventromesial row of 3 tubercles.

Hooks on ischia of third and fourth pereopods (like Fig. 4e) simple, that on third overreaching basioischial articulation, that on fourth not overreaching articulation but opposed by prominent tubercle on corresponding basis. Coxa of fourth pereopod with prominent, subvertically oriented caudomesial boss; that of fifth with smaller one strongly compressed in longitudinal plane of body. Sternum between third, fourth, and fifth pereopods comparatively deep with mat of plumose setae extending mesially from ventrolateral margins.

First pleopods (like Fig. 4b, d, g) as described in "Diagnosis." Uropod with both lobes of basal podomere bearing small acute spine; both rami with distolateral spines, and distomedian spine on mesial ramus situated distinctly proximal to subtruncate distal margin.

Allotypic female.—Differing from holotype, except in secondary sexual characters, as follows: apex of rostrum almost reaching distal extremity of antennular peduncle; small corneous marginal spines flanking base of short, narrow acumen; suborbital angle almost obsolete; left cervical spine very small but with sharp apex; abdomen slightly longer than carapace; chelipeds perhaps regenerated but similar to chela of paratypic female (like Fig. 4m); comparatively few plumose setae on third maxilliped; mesial surface of palm with row of 6 tubercles subtended by dorsal one of 6 and ventral one of 3; opposable margin of fixed finger with single row of 9 tubercles, third from base largest, on proximal half of finger with larger more ventrally located one almost at midlength; single row of minute denticles extending between tubercles and continuing to base of corneous tip of finger; opposable margin of dactyl with row of 13 tubercles, sixth from base largest, in proximal half (left with 12, fourth from base largest), minute denticles as on fixed finger; tubercles on mesial surface of dactyl weaker than those in holotype; merus with 2 premarginal tubercles larger than others on dorsodistal surface, ventral surface with mesial row of 12 tubercles and lateral one of 11, oblique row inseparable from lateral; ischium with mesial row of 4 (2 very small) tubercles. (See Table 3 for measurements.)

Annulus ventralis (Fig. 41) as described in "Diagnosis."

Morphotypic male, form II.—Differing from holotype in following respects: rostral margins bearing minute tubercles at base of slender, short acumen, latter reaching ultimate podomere of antennular peduncle; abdominal pleura with posteroventral extremities (especially of sixth segment) angular; flagella of antennae broken; third maxilliped, probably regenerated at least in part, reaching midlength of proximal podomere of antennular peduncle, comparatively few plumose setae present; mesial surface of palm of chelae with mesialmost row of 6

tubercles, 6 in that on dorsal flank, and 4 in that on ventral flank; fixed finger of right chela with row of 10 tubercles (13 on left), third from base largest; opposable margin of dactyl with upper row of 19 (15 on left) and lower row of 8 (9 on left); mesial surface of carpus of cheliped with additional tubercle between proximalmost and that near midlength; ventral surface of merus with mesial row of 14 tubercles and lateral one of 15 (left with 12 and 14 respectively); ischium with only 2 tubercles marking mesial row in holotype. Hooks on ischia of third and fourth pereopods and bosses on fourth and fifth much reduced.

First pleopods (Fig. 4c, f) with all terminal elements positioned as in holotype; mesial process comparatively much heavier, remaining ones smaller and not nearly so clearly differentiated as in holotype; subapical setae and shoulder much less prominent. Juvenile oblique suture clearly defined on shaft.

Type locality.—Semi-permanent pool in roadside ditch on Farm Road 2497, 1.2 mi (1.9 km) SE of intersection with State Route 94, southwest of Lufkin, Angelina County, Texas. The pool of grayish cloudy water, some 3 by 13 and no more than one-half m in depth, was excavated in a sandy clay soil and is situated adjacent to a wooded area in which *Pinus* and *Quercus* are the dominant plants; grasses and a few sedges are present in the open ditch adjacent to the pool. Both on 13 Apr and 9 Nov 1987, two other crayfishes, *Procambarus* (*Girardiella*) *curdi* and *Fallicambarus* (*Creaserinus*) *hedgpethi* shared the pool with *P. (O.) nechesae*.

Disposition of types.—The holotype, allotype, and morphotype (♂ I, ♀, ♂ II) are deposited in the National Museum of Natural History (Smithsonian Institution), numbers 219733, 219735, and 219734, respectively, as are the paratypes consisting of 2 ♂ I, 9 ♂ II, 8 ♀, 6 j♂, and 10 j♀.

Size.—The largest specimen available is a first form male having a carapace length

of 40.8 mm (postorbital carapace length 31.2 mm); the smallest has corresponding lengths of 30.8 and 24.2 mm. Length of females carrying eggs or young are not available because of lack of such specimens.

Range and specimens examined.—This crayfish has been found at the following localities in the Neches River basin of Angelina and Trinity counties, Texas. Angelina County: (1) Type locality, 1 ♂ I, 1 ♂ II, 1 ♀, 15 Apr 1987, GBH & HHH; 1 ♂ II, 9 Nov 1987, BFK & HHH. (2) Burrows in flooded roadside ditch in southeastern Lufkin, 1 ♂ I, 1 ♀, 13 Apr 1987, Mike Whiteman & HHH. (3) Drainage ditch and pool at Angelina County Airport, about 5 mi (8.0 km) S of Lufkin, 1 ♂ I, 4 ♂ II, 4 ♀, 6 j♂, 10 j♀, 13 Apr 1987, Harold Brockman, MW, & HHH. (4) Roadside pool at junction of Farm Road and road into airport, about 3.5 mi (5.6 km) S of Lufkin, 13 Apr 1987, MW & HHH; 1 ♂ II, 1 ♀ 10 Nov 1987, BFK & HHH. Trinity County: (5) Caney Creek, 12 mi (19.2 km) NE of Trinity on St Rte 94, 1 ♂ II, 16 Apr 1987, BFK & HHH.

Variations.—Perhaps the most conspicuous of the variations noted is in the rostrum, which in some of the juvenile specimens is not so strongly contracted anteriorly and bears prominent marginal spines; in most of the specimens there is at least a trace of these spines, but in a few of the larger individuals there is hardly an indentation along the gently contracting margins. In most specimens the antennal scale is broadest at about midlength, but occasionally the greatest width is clearly more proximal, and as for the length, the apices reach to or beyond the tip of the acumen. Cervical spines, like the marginal spines on the rostrum, may be strong in juveniles, but may be reduced to tubercles or even become, at most, rudimentary in the adults. The epistome is usually little different from that illustrated for a paratype in Fig. 4h, but in the small male from locality 5 its shape approaches that of an isosceles triangle. The ventrolateral surface of the ischium of the third maxilliped may be almost hidden by the dense mat of

plumose setae borne on it, or the setae may be comparatively small, sparse, or so inconspicuous that the podomere appears almost naked. The telson bears 2 to 4 spines in the caudolateral corner of the cephalic segment. Variations in the secondary sexual characters are almost all so slight that they are not noteworthy, but the proximomesial angle of the first pleopod of the male does show a conspicuous variation which in some is produced into a conical prominence (as in right member of Fig. 4d) that is reminiscent of, if not homologous to, the proximomesial spur typical of several species groups, but not of most members of *Ortmannicus*.

Relationships.—*Procambarus (O.) nechesae* has its closest relationships with *Procambarus (O.) geminus* Hobbs (1975), *P. (O.) lecontei* (Hagen, 1870), and *P. (O.) texanus* Hobbs (1971). This is most clearly revealed in the short, caudally bent terminal elements of the first pleopod of first form males and in the configuration of the annulus ventralis. *Procambarus (O.) nechesae* resembles *P. (O.) geminus* more closely than it does the other two, but it may be distinguished from this crayfish and *P. (O.) lecontei* by the less strongly reflexed (40 to 50 degrees instead of 80 to 90 degrees) terminal elements of the first pleopod of the male, by the strong tubercle on the basis of the fourth pereopod which opposes the hook on the corresponding ischium, and usually by the more strongly tapered margins of the rostrum. (Some of the females of *P. (O.) nechesae* and *P. (O.) geminus* are virtually impossible to distinguish.) The new crayfish differs from *P. (O.) texanus* in several striking respects: the areola is usually broader (7.3 to 10.9, avg. 8.8, as opposed to 8.5 to 16.4, avg. 12.8, times longer than broad); the first pleopods of the male are strongly asymmetrically situated with their proximomesial extremities overlapping as opposed to being almost symmetrically disposed; there is a strong tubercle on the basis of the fourth pereopod that opposes the hook on the corresponding ischium in *P.*

nechesae that is lacking in *P. texanus*; the sternum in the female of the former is much more weakly tuberculate than that of the latter, and the tongue-like prominence, so conspicuous on the caudomesial part of the annulus ventralis of *P. nechesae*, is represented at most by a rudiment in *P. texanus*. These three species constitute a closely allied group and may well represent geographic races of a single species. Until their ranges are more clearly determined and evidence of gene exchange between them is found, assigning them specific rank seems preferable to me.

Ecological notes.—All of the known members of this species, except the single small male collected in Caney Creek (locality 5), were collected from burrows consisting of a single subvertical shaft or from temporary or semi-permanent pools in roadside ditches. Caney Creek, flowing over a bed-rock bottom, is a clear stream 3 to 10 m wide and with depths exceeding 1 m. The single specimen, the only crayfish obtained at that locality, was found under a rock adjacent to the shore. It seems likely to me that it had wandered or perhaps was washed into this unlikely habitat during a period of high water.

Etymology.—The name is derived from the Neches drainage basin, the only watershed in which it has been collected.

Crayfish associates.—Taken from the same pool, or dug from burrows adjacent to those occupied by *P. (O.) nechesae* were members of the following species: *Fallicambarus (F.) devastator*, *F. (Creaserinus) fodiens*, *Procambarus (Scapulicambarus) clarkii*, *P. (Girardiella) curdi*, and *P. (G.) nigrocinctus*.

Procambarus (Pennides) dupratzi Penn

Procambarus dupratzi Penn, 1953:1.

Procambarus (Pennides) dupratzi.—Hobbs, 1972:10.

New records.—Jasper Co.: Small creek 0.3 mi (0.5 km) E of St Rte 63, 16 mi (25.6 km) N of jct with US Hwy 90, 1 ♂ I, 1 ♂ II, 3 j♂,

4 j♀, 17 Apr 1987, GBH & HHH. Polk Co.: Menard Creek 16 mi (25.6 km) W of Tyler Co line on US Hwy 190, 2 ♂ II, 1 ♀, 10 j♂, 9 j♀, 12 Nov 1987, BFK & HHH. Tyler Co.: Russell Creek at US Hwy 287, 7 ♂ II, 5 ♀, 8 j♂, 3 j♀, 12 Nov 1987, BFK & HHH.

Remarks.—The specimens cited here were taken from lotic habitats in which the water was translucent but coffee-colored.

Procambarus (Scapulicambarus) clarkii
(Girard)

Cambarus Clarkii Girard, 1852:91.

Procambarus (Scapulicambarus) clarkii.—Hobbs, 1972:12.

New records.—Angelina Co.: SE part of Lufkin, 2 ♂ I, 1 ♀, 13 Apr 1987, MW & HHH. Trib to Moccasin Creek at Farm Rd 2497, 1 ♀, 4 j♂, 3 j♀, 4.9 mi (7.8 km) SE of St Rte 96, 9 Nov 1987, BFK & HHH. Polk Co.: Menard Creek on US Hwy 190, 16 mi (25.6 km) W of Tyler Co line, 1 j♀, 13 Nov 1987, BFK & HHH. Creek 5 mi (8 km) W of Livingston on US Hwy 190, 1 j♂, 13 Nov 1987, BFK & HHH. Trinity Co.: 4.0 mi (6.4 km) SW of Farm Rd 357 on Rd 2262, 1 ♀, 1 j♂, 1 j♀, 16 Nov 1987, BFK & HHH.

Remarks.—Except for the adult specimens from the first locality listed, which were dug from shallow, flooded, burrows, all were found either in creeks or in a roadside pool.

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